CLAIMS

What is claimed is:

1. A control panel assembly comprising:

a bezel;

a circuit board having an electrical circuit;

a key cap that is disposed between the bezel and the electrical circuit on the circuit board, the key cap undergoing a compression between the bezel and the electrical circuit; and

the key cap being buckled due to the compression.

2. The control panel assembly of claim 1 wherein the key cap is in contact with the electric circuit and the key cap is in contact with a protrusion that extends from the bezel.

3. The control panel assembly of claim 1 wherein the key cap is connected to a keypad disposed between the bezel and the circuit board.

4. The control panel assembly of claim 1 wherein:

the key cap has a length that extends along a longitudinal axis between the bezel and the circuit board; and

the buckling of the key cap results in a bend along the longitudinal axis, thereby forming an angle of about 160 degrees or less.

5. The control panel assembly of claim 1 wherein the key cap that experiences buckling comprises at least one column having a slenderness ratio, (l/k), according to the formula:

$$\frac{l}{k} \geq \sqrt{\frac{C\pi^2 E}{P_{cr}/A}}$$

wherein l is the length of the column;
wherein k is the radius of gyration;
wherein P_{cr}/A is the critical load;
wherein E is the modulus of elasticity; and
wherein C is the end-condition constant and ranges from 1/4 to 4.

6. The control panel assembly of claim 5 wherein the at least one column has one end fixed and one end free and C, the end-condition constant, ranges form 1/4 to 2.

7. The control panel assembly of claim 1 wherein the key cap comprises at least four columns arranged concentrically about an axis.

8. The control panel assembly of claim 7 wherein the at least four columns are connected to one another.

9. The control panel assembly of claim 1 wherein the key cap comprises an elastic material having a modulus of elasticity that is about 500 psi or less.

10. The control panel assembly of claim 1 wherein the key cap comprises a thermoplastic elastomer or thermoset elastomer.

11. The control panel assembly of claim 10 wherein the key cap comprises silicone rubber.

12. The control panel assembly of claim 1 wherein the key cap comprises at least one helical column.

13. The control panel assembly of claim 12 wherein:

the column has a rotational size and a length;

and the pitch of the column is at least as great as ½ the rotational size of the face along the length of the column.

14. The control panel assembly of claim 5 wherein the at least one column is a helix.

15. The control panel assembly of claim 12 wherein the key cap comprises at least four helical columns arranged concentrically about an axis.

16. The control panel assembly of claim 15 wherein the at least four helical columns are physically connected to each other.

17. The control panel assembly of claim 16 wherein the key cap comprises an elastic material having a modulus of elasticity that is less than about 500 psi.

18. The control panel assembly of claim 17 wherein the key cap comprises a thermoplastic elastomer and a thermoset elastomer.

19. The control panel assembly of claim 18 wherein the key cap comprises silicone rubber.

20. The control panel assembly of claim 1 comprising:

the key cap has a first column and a second column having a first cross-sectional surface area and second cross-sectional surface area;

the first column and the second column are physically connected by a connecting web having a cross-sectional surface area between the first column and the second column that is about 10% or less than the cross-sectional area of at least one of the first column and the second column.

21. A control panel assembly comprising:

a bezel;

an electronic circuit board having electronic circuitry;

a keypad disposed between the bezel and the electronic circuit;

a means for reducing a magnitude of a force exerted on an underside surface of the bezel when the keypad is in physical communication with the bezel and the circuit board.

22. The control panel assembly of claim 21 wherein the means for reducing the force exerted on the underside surface of the bezel is a key cap of the keypad that is capable of buckling when the key cap is in contact with the electronic circuitry.

23. A method for assembling a control panel assembly comprising:

placing a key cap between a bezel and a circuit board;

advancing the key cap into contact with an electrical circuit on the circuit board;

causing the key cap to buckle.

24. The method of claim 23 wherein the key cap comprises at least four columns arranged concentrically about an axis.

25. The method of claim 24 wherein the at least four columns are physically connected to one another.

26. The method of claim 23 wherein the key cap is made of an elastic material having a modulus of elasticity that is less than about 500 psi.

27. The method of claim 26 wherein the key cap comprises silicone rubber.

28. The method of claim 23 wherein the key cap comprises at least one helical column.

29. The method of claim 28 wherein the key cap comprises at least four helical columns arranged concentrically about an axis.

30. The method of claim 29 wherein the at least four helical columns are connected to each other.

31. The method of claim 30 wherein the key cap comprises an elastic material having a modulus of elasticity that is less than about 500 psi.